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ABSTRACT

At Humber College (HC) in Toronto, Ontario, Canada, the Digital Electronics (DE) program utilizes a computerized learning infrastructure called Computer Managed Learning (CML). The program, which has been under development for several years, is flexible enough to build a unique program of studies for each individual student and allows for the continuous, year-round intake of students. The DE program involves a sequence of learning modules, each with a defined goal and a sequence of stated objectives to meet that goal. The CML system is able to test a student's success in reaching each objective and can generate study guide packages with learning activities for each objective. For each objective, students complete open-book homework assignment questions generated by the computer before moving on to the next module. Students must achieve a minimum grade within a set number of tries before a mandatory intervention by the evaluator. Students can access the CML system on campus, or from a home computer using a modem. The CML system provides a comprehensive set of statistics on individual as well as group success, allowing instructors to continually identify and correct weaknesses in the system. Using the concept of "Tree Branching," CML modules can be mixed and matched into various logical sequences to produce new programs of instruction. Attached to the conference paper is a set of five learning modules, each with objectives and learning activities, developed for use in understanding and implementing CML systems and techniques: (1) Infrastructure for Learning Management; (2) Individualized Instruction; (3) Continuous Intake; (4) Computer Managed Learning; and (5) Learning Management Systems. (PAA)

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An Infrastructure for Continuous Intake Individualized Education

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Paper presented at the National Institute for Staff and Organizational Development's Annual International Conference on Teaching Excellence and Conference of Administrators (14th, Austin, TX, May 24-27, 1992)

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AN INFRASTRUCTURE

FOR CONTINUOUS INTAKE

INDIVIDUALIZED EDUCATION

Educators have built some of the world's best education systems in North America. Yes, excellent management systems have been developed for registering students etc., however, how many of us have developed a computerized infrastructure to manage learning? How many of us have built a learning system that is too dependent on one person? How many of us have built a learning infrastructure that is the best effort of ALL the faculty AND students involved?

Computer Managed Learning

The Digital Electronics program at Humber College Toronto has a computerized learning infrastructure that has been under development now for several years called Computer Managed Learning (CML[1]). CML operates on a Micro VAX VMS platform and can be accessed by any of our faculty and students from any VAX terminal in the college or a micro computer with a modem installed from outside the college. The system is flexible enough to build a unique program of studies for each individual student's needs within our resources.

The Digital Electronics program was first defined in terms of a sequence of modules, each, with a stated defined goal. Each goal has a sequence of stated objectives to meet that goal. CML has the ability to test a student's success in reaching each objective. CML can produce study guide packages with learning activities for each objective.

Although there are many programs and courses throughout North America that have implemented some aspects of a deviation from traditional methods of instruction, the Digital Electronics program at Humber College has implemented individualized instruction, continuous intake, and computer managed learning together.

Many college programs have tried individualized instruction in a semester setting where all students start and end their courses together. This tends to be incompatible with the concept of individualized instruction where learning should be relatively independent of time. Many college and university programs have implemented various forms of computer managed learning, normally with semestered courses. The concept of computer managed learning seems to produce a more compatible fit with courses that are individualized in their instruction format. Very few colleges and universities have implemented continuous intake. Even fewer have implemented all three concepts simultaneously. Computer management of the model that utilizes all three concepts seems to be the best application of computer managed learning.

There are various degrees in which one can implement the computer managed learning system. The CML system used by the Digital Electronics program at Humber College allows the teacher or learning manager to implement as little or as much of the system as required at any given stage. It is best to start small and add on as one becomes more experienced. In the simplest form, one can use it as a test - lab grade record system. In this way each test is graded manually and the grades are entered manually for each student project. From this implementation the facilitator would be able to produce weighted grade reports for each student and group statistical analysis.

The next most obvious use of the system is to identify module statements, objective statements and then set up test banks that co-relate to the objective statements. With these questions, it is possible to test each student with controlled random sets of questions for each objective of the student's program. Each student can enter their answers in the system and have them graded and recorded.

Testing Application

In the Digital Electronics program the complete use of the test bank functions is in use. The following is a description of how it is used. This is not meant to be how it should be used, but an example of how it can be used. For each objective, students are given open book homework assignments that must have a minimum grade of 80 percent before the student can proceed to the next assignment. A student may have three tries at each of these assignments before a mandatory intervention by the evaluator. The computer will generate random questions in each of these assignments. As soon as the minimum grade of 80 percent is reached the student can proceed to the next assignment. The highest of the grades will be used for the summative evaluation. The homework assignments will count for 20 percent of the theory evaluation for each subject.

Each closed book supervised mid term and final subject tests and exams are delivered by the CML system to the student in the college's test centre and must have a minimum grade of 60 percent before the student can proceed to the next assignment. A student may have two tries at each of these tests before a mandatory intervention by the evaluator. The computer will generate random questions in each of these assignments. Once the minimum grade of 60 percent is reached the student will proceed to the next assignment. The highest of the grades will be used for the summative evaluation.

Each lab project with a lab test will count for 60 percent of the raw score for the lab and the lab test will count for 40 percent of the raw score for each lab. All of the lab project raw scores will be averaged for the Lab grade for each subject. Some lab project scores are entered by the teacher and others are created by having the student enter their measurements and data from the lab project.

The final Theory grade and the final Lab grade will each count for fifty percent of the final grade in each subject. The computer manages all of the scores.

At the moment over two thousand questions have been developed in the test banks for the Digital Electronics program. It has been determined that the weighting of evaluation is of minor importance compared to making sure that students have mastered the skills and objectives that are required. In fact, the students proposed the weighting scheme for the grades, and was approved by faculty and adminstration, and adopted without change. It is also maintained in our system that the main purpose of an evaluation is to find out what the student DOESN'T know. It is with this information that students can be helped.

Study Guides

The module study guide draws together the module statement, the resources, the objective statements, and the learning activities. When activating the module study guide function, a template is automatically generated. All the user has to do is to type in the resources and the learning activities. Although it has not yet been attempted to incorporate graphics into the test bank and study guide files, the system is capable of handling these.

The complete study guide package brings together all of the required module packages produced by the CML system. A complete set of study guide packages make up the courses for the Digital Electronics program. It is possible using this technique for a course to be made up individually for any student. From the student's perspective, a selection of appropriate module study guides bound together would make up that student's unique course.

The module study guide and test questions can be corrected on line in minutes as problems occur. Initially a small number of these study guides are printed. This forces a new revised set to be printed. The new revised set will incorporate all of the changes to date. The system will look after renumbering sections and pages etc. The study guide given to our students comprises of a front cover sheet, the course outline, the module study guides, and all diagrams required to answer the assignments.

The test bank history function provides a statistical print out of the success, or lack there of, for every question in the test bank. When a problem is identified, what has to be researched is, whether the question is the problem, or whether there are insufficient learning activities to answer the question. The corrections can be made instantly on line to benefit all others who follow.

With the use of a home computer, students can access assignments and study guides. When assignments are complete, students can also enter their answers at home into the system for grading and receive an immediate report back regarding their success.

Updating

What has been developed to date has to run well before adding other features. Our whole program is being rewritten continuously and brought to the standards previously mentioned. As this occurs, changes in technology can be constantly added and updated. As other good resources are discovered such as video tapes, and inter active learning systems, they too will be added and evaluated. The most important part is here now - infrastructure. It is in electronic format for easy editing. The system will be here even if the creators are not. It is the best effort of all teachers and all students.

Implementation

The following steps are required to implement the computer managed learning system.

1. Write module statements.
2. Prepare a course outline.
3. Write objective statements for each module statement.
4. Prepare test questions for each objective statement.
5. Prepare diagrams for each test question requiring them.
6. Prepare learning activities for each objective statement.
7. Prepare a module package for each module statement.
8. Prepare a course map.
9. Assemble module packages into logical sets to make up course study guides.
10. Enrol students.
11. Facilitate the learning system.
12. Track student progress.
13. Prepare student reports.

The teacher can now observe the fruit of his or her efforts. The module statements, the objective statements, and the learning activities all come in one decent looking module package. One can then take any number of these modules, combine them in any logical order and produce a complete study guide for a complete course. The modules don't necessarily have to share the same test bank.

The course map puts together all the testing parameters and the order of sequence of the modules. The teacher can identify how and when each objective is going to be tested.

Enroling students initiates activity with the learning system. In the individualized system of instruction, the teacher observes how all the previous activities he or she has prepared start to activate learning with the student. One quickly learns from the questions the students are asking or not asking, what parts of all the previous preparation are successful and what parts still need some more work.

As each student progresses through their course, CML delivers homework assignments, supervised examinations, checks answers to assignments and examinations, provides students with reports on test achievement, allows entry of grades from faculty graded projects such as labs, checks data gathered from lab measurements, and provides comprehensive statistics of student's grades, classes, objectives, and test question success.

As each student progresses through their course, students and faculty, at any time, can identify errors in test questions, answers, study guides, and suggest improvements that can be immediately implemented on line. Each student there after will receive the immediate benefit of these dynamic improvements.

Statistics

The CML system provides the teacher with a very comprehensive set of statistics both on individual student progress as well as group success. The teacher can use these statistics to learn where weaknesses lie in the system. With some critical path analysis the teacher will be able to correct problems that affect the greatest number of students first and then work down to those affecting the least number of students.

Advantages and Challenges

The Digital Electronics program has become totally modular. With these modules the student can take the same program days or evenings, full time or part time. With modular instruction students are able to do more of their program at home, on the job, or other places other than the classroom. This provides better utilization of space and hardware. "Class sets" of hardware are a thing of the past. For example, in a traditional setting of 20 students doing a lab project paired in twos, would required 10 sets of hardware. However, if all of the students do not require the same hardware at the same time, maybe one or two sets are all that are required.

Scheduling of space and faculty are much simplified. Faculty are scheduled to fixed areas of learning. The students attend as they need to. The experience in the Digital Electronic program is that approximately 50 percent of the students need to attend at any given time for instruction and resources they can't find anywhere else. This doesn't mean faculty are any less busy, they are continually serving students on an individual basis.

Perhaps the most important advantage of individualized instruction is the fact that the students are forced to learn how to learn on their own. If there is any one single important gift a student walks away with for the future, this is it. When they are not given any other choice in the matter they submit to it and begin to learn how to learn on their own. Most become confident learners and are very pleased with themselves.

Continuous Intake

One of the most important advantages of year round continuous intake is that the student can start his or her course when it is convenient to them. The convenience of when they want to start a course may be dictated by their personal goals and when they have to be achieved by. It may be determined by some production goal of an employer. A student who is unemployed may wish to start their course in April rather then sit unemployed or take part time jobs until an opportunity to start occurs in September. Perhaps if they have to support themselves until September as well as take the course, they won't be able to afford to take the course. In any other part of the market place, when a buyer wishes to make a purchase, they don't wish to wait 6 months to receive their purchase. Why should the purchase of an education be any different? Continuous intake of students does, however, preclude the use of individualized instruction.

When participants trickle into a program or course on a continuous intake basis, they trickle out. Jobs come available all year round, not just in May or June. When graduates trickle out, there may be only one or two graduates competing for the jobs available in that time period. This provides a lot less competition than if 50 or 100 are graduating for the same number of jobs in May or June. Certainly in these periods of recession this feature is greatly appreciated by graduates. In fact, if a long period of recession should continue, and graduation doesn't occur on a more continuous basis, we will endanger our very existence. Another benefit occurs when employers learn that graduates are available for graduation all year round, they will go looking for graduates to place at odd times of the year because they can be reasonably sure it won't be long until someone is available. They will be able to fill positions as they become available. All of these features have benefited the participants and graduates of the Digital Electronics program at Humber College.

Resource Utilization

With continuous intake all year round there is much better utilization of resources. Instead of resources lying idle for up to 4 months of the year, they are utilized all year. As a result more students can use the same resources in the period of one year. Students also pay their tuition all year providing added income to the institution.

Faculty involved in year round continuous intake programs can choose their professional development and vacation periods at times that may be more advantageous to the faculty. For example, in the Digital Electronics program at Humber College there are 2550 student-teacher contact hours annually. Since each professor's annual contracted teaching load is approximately 650 hours, then the load can be shared by approximately 4 professors. It works out that in any given week, one of the four professors can be off duty, either on vacation, doing course preparation, or professional development activities. When these activities occur is irrelevant for any given week of the year, because each student is working individually and each week of instruction is the same, only the players change.

Continuous intake requires more complex management of course materials, resources and student records. The greatest challenge is knowing how many pieces of any given resource is needed at any given time. With semestered groups, one can produce "class sets". However, with continuous intake, one doesn't require class sets of anything. Depending upon how often, and, for how long, will determine the number required. For example, if there are 60 students in a course and a resource is used for 10 percent of the student's course, than 6 units should suffice. Having to purchase only 6 is definitely an advantage, but the difficulty lies in determining accurately what percentage of the time it will be used. The worst case occurs when 5 or 6 more students than usual start on a given day.

College global resources are often geared for semester intake, and, if continuous intake groups represent small numbers then it is often difficult to get the attention of services like libraries and cafeterias at "odd" times of the year.

Inexperienced faculty find a great deal of challenge starting in a continuous intake format. This is not from an attitude problem, but, not being familiar enough with course content to be able to function in all parts of a course simultaneously. Teaching in a lock step semester mode, the teacher usually only has to be on top of a week or two's work at any one time. They can prepare ahead as required. As they teach a course repeatedly, they will become more comfortable being able to deal with all parts simultaneously. In a continuous intake setting, the teacher has to be very familiar with ALL parts of the course ALL of the time.

Multi Media

In the Digital Electronics program at Humber College, the first decision on multi media learning activities was to install a book referenced system. Books are still the most widely distributed form of information. The use of books provides the greatest portability of the system. All other media added will be in addition to books, not as a replacement of books.

Tree Branching

Tree branching is the concept of mixing and matching learning modules into various logical sequences to produce new programs of instruction. Ten different courses may share twenty common modules between them. Other courses that branch off may share other common modules that the entire set of courses don't share and so on. Each and every objective, test question, and learning activity produced and used by the Digital Electronics program are contained in a computer managed learning data base. In minutes, new courses can be sequenced in the computer using existing test banks and study modules.

Distance education can be defined as any learning that occurs when a student is remote from the central location of resources. Any student with a home computer, printer, and modem can access the computer managed learning system used by the Digital Electronic program, to draw assignments, enter answers to assignments, have assignments checked by the computer, produce reports on errors in an assignment, produce histories of their past performance and communicate by electronic mail with professors when they are not available to them. One may feel that after reading this that there may not be any interaction between students and faculty left. This would be a sad day. The learning lab facility provided in the Electronics Digital program provides both hands on practical projects and a time when students can discuss matters with other students and the faculty. There are always two professors available 25 hours per week to facilitate discussion and problem solving with students on an individual or small group basis on demand.

Conventions

When one starts to talk about "Tree Branching" and "Computer Managed Learning" and "Individualized Learning" and "Continuous Intake" systems, and sharing these systems with other colleges and universities (directly or through a point of sale), one has to begin being concerned about conventions very early in the game or the sharing of electronic media becomes very difficult very quickly. Educators, for the most part, historically do not share much in the way of conventions. Most have operated very independently for a long time and many attitudes will have to change before conventions can take hold. When you develop something new, are you developing it strictly for your own use, or for use by others as well? If you have others in mind you will start to be concerned about conventions.

Conclusions

It is generally felt that the model of the learning infrastructure used for the Digital Electronics Program at Humber College in Toronto is ready for the challenges and changes that are going to occur in the twenty first century. We have learned that review and change and updating are an on going continuous daily challenge that doesn't occur every set number of years. We have in place an on line system that invites change and improvement daily. With the CML model, we are able to gear towards the individual needs of students with different learning preferences. Lastly, the most important of all advantages that we have identified with this model is that students are forced to learn how to learn.

Footnote 1:

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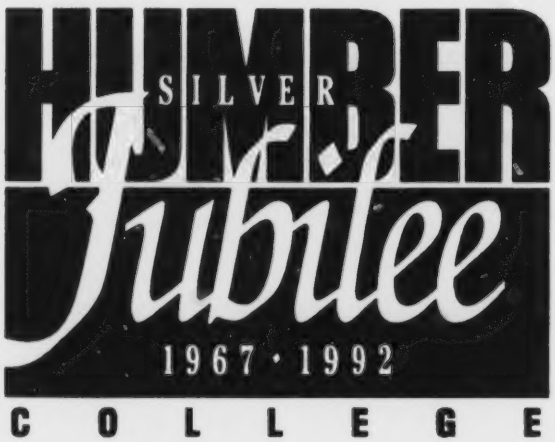
Infrastructure

For

Learning Management



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Notice to readers:

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Module 1

Infrastructure for Learning Management

Module Overview

Participants will be able to identify the requirements for building an infrastructure to manage learning.

Resources

General

Slide presentation

Print

Contained within this module

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Objectives

Objective	Learning Activity
1. Participants will identify and observe the three major concepts used in the Digital Electronics Program at Humber College to build a learning system model that will be compatible with the requirements of education in the twenty first century.	**Reading Activities:** (a) Individualized instruction. (b) Continuous intake. (c) Computer managed learning (d) For a more detailed discussion on how each of these concepts have been used at Humber College in the Digital Electronics program, read the information sheet on page 4 of this module.

Objective	Learning Activity
2. Participants will identify future trends that fit the model of individualized instruction, continuous intake and computer managed learning that will be implemented in the Digital Electronics program at Humber College.	**Reading Activities:** (a) Multi media (b) Interactive learning (c) Tree branching (d) Distance education (e) Expert systems (LMX) (f) Conventions for sharing (g) On the job training projects (h) For a more detailed discussion on how each of these concepts plan to be used at Humber College in the Digital Electronics program, read the information sheet on pages 5 and 6 of this module.

Three Concepts of Infrastructure

Information sheet for Objective 1.

Although there are many programs and courses throughout North America that have implemented some aspects of a deviation from traditional methods of instruction, the Digital Electronics program at Humber College has implemented individualized instruction, continuous intake, and computer managed learning together.

Many college programs have tried individualized instruction but usually in a semester setting where all students start and end their courses together. This tends to be incompatible with the concept of individualized instruction. Many college and university programs have implemented various forms of computer managed learning, normally with semestered courses. The concept of computer managed learning seems to produce a more compatible fit with courses that are individualized in their instruction format. Very few colleges and universities have implemented continuous intake. Even fewer have implemented all three. Computer management of the model that utilizes all three concepts seems to be the application that makes the best use of computer managed learning.

Future Additions to Infrastructure

Information sheet for Objective 2.

In the Digital Electronics program at Humber College, the first decision on multi media learning activities was to install a book referenced system. Books are still the most widely distributed form of information. The use of books provides the greatest portability of the system. All other media added will be in addition to books, not as a replacement of books. We have added some video tapes to the system. Unfortunately other forms of media very often require additional hardware to make them operate. All 35 mm slides have been removed from the system of instruction. Interactive computer systems will probably provide the best alternatives in multi media.

Interactive learning is very much in its infancy both in hardware and software. The compact disk is very much in its infancy and qualified estimates indicate that they will be able to hold several millions of times the information they can currently hold. There are no technical reasons why CD players for computers can't be as cheap as they are for audio systems. Once this system is perfected there will be tremendous opportunities for educators to market this type of software in their areas of specialty. Better learn what a story board is all about.

Tree branching is the concept of mixing and matching learning modules such as the one you are reading now into various logical sequences to produce new programs of instruction. Ten different courses may share twenty common modules between them. Other courses that branch off may share other common modules that the entire set of courses don't share and so on. Each and every objective, test question, and learning activity produced and used by the Digital Electronics program are contained in a computer managed learning data base. In minutes, new courses can be sequenced in the computer using common test banks and study modules. The dilemma faced by the Digital Electronics program is that due to the popularity of the program every inch of its allotted space and resources are dedicated to one program and if new programs were developed, there would not be space for the students. There is a constant waiting list of several months to start the program.

Distance education should be defined as any learning that occurs when a student is remote from the central location of resources. Any student with a home computer, printer, and modem can now access the computer managed learning system used by the Digital Electronic program, draw assignments, enter answers to assignments, have assignments checked by the computer, produce reports on errors in an assignment, and produce histories of their past performance. If they have a laser printer they could print their study guides at home for each module. It will be some time before low cost communications will be available for one to use interactive learning systems that include voice and pictures and graphics. This will come when neighbourhoods are "wired" with fibre

optic technology or home computers can inexpensively add the required hardware. The interactive disk software then could move from college to home. Many education dollars can be saved and invested into interactive learning when the learner provides his or her own space at home for a larger percentage of their course and fewer dollars are invested into large physical institutions. One may feel that after reading this that their may not be any interaction between students and faculty left. This would be a sad day. The learning lab facility provided in the Electronics Digital program provides both hands on practical projects for the students using resources that the student could not normally afford by him or herself and it also provides a time when the students can discuss matters with other students and the faculty. There are always two professors, both available 25 hours per week to facilitate discussion and problem solving with students on an individual or small group basis on demand.

Expert systems of computer managed learning are currently available that not only manage student testing, records and learning activities as does the LMS system used by the Digital Electronics program, but also steers the student to other learning activities in the system when a student runs into problems. This provides a customizing of learning activities automatically by the computer to suit the needs of the student. Conversely, when a student demonstrates previous mastery of certain skills, the expert system avoids duplication of unnecessary or redundant instruction. The Campus America people that have provided the LMS system used by the Digital Electronics program are now marketing a system called "LMX" that is an expert computer managed learning system. We hope to obtain this system soon for Humber College.

When one starts to talk about "Tree Branching" and "Computer Managed Learning" and "Individualized Learning" and "Continuous Intake" systems, and sharing these systems with other colleges and universities (direct or through a point of sale), one has to begin being concerned about conventions very early in the game or the sharing of electronic media becomes very difficult very quickly. Educators, for the most part, historically do not share much in the way of conventions. Most have operated very independently for a long time and many attitudes will have to change before conventions can take hold. When you develop something new, are you developing it strictly for your own use, or for use by others as well? If you have others in mind you will start to be concerned about conventions.

Module 2

Individualizing Instruction

Module Overview

Participants will identify and observe the concepts used in the Digital Electronics Program at Humber College to individualize instruction.

Resources

General

Slide presentation

Print

Contained within this module

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Objectives

Objective	Learning Activity
1. Participants will be able to identify the advantages of individualizing instruction.	**Reading Activities:** (a) Participants learn at their own rate. (b) Lends itself easily to continuous intake. (c) Lends itself to computer managed learning. (d) Participants can obtain the same course part time, full time, days or evenings. (e) More portable. (f) Better utilization of space and hardware. (g) Easier scheduling. (h) Participants are forced to learn how to learn. (i) Refer to page 4 and 5 for more detailed information on the advantages to the student by individualizing instruction.

Objective	Learning Activity
2. Participants will be able to identify the challenges in implementing individualized instruction.	**Reading Activities:** (a) Changes in attitude. (b) Challenging for inexperienced faculty. (c) Requires more complex management of materials and records. (d) Teachers have to be on top of ALL parts of their course ALL of the time. (e) Refer to page 6 for more detailed information on the challenges implementing individualized instruction.

Advantages of Individualizing Instruction

Participants can learn at their own rate. It has been proven and observed in our class rooms by every teacher who has ever taught that students each learn at a different rate. Why do we continue to expect students to learn all the parts of a course within a fixed framework of time that is not compatible with their rate of learning? Letting students learn at their own rate decreases the attrition rate very significantly. The Digital Electronics program at Humber College retains close to 80 percent of its students. Very few students drop out because of academic problems. Drop outs are now due to financial problems (number one) and other personal problems that are totally unrelated to their academic ability. Many students that have to drop out of the Digital Electronic program show up again a few months later as part time or evening students. They can pick up where they left off. By the nature of individualized learning if time is no longer a constriction of time in the true sense, there is no longer a need for fixed semester periods. Should learning be a function of time? Or, should time become a function of learning where the student pays for the time required to learn? Some pay more, some less for the same learning requirements.

Individualized instruction then lends itself ideally to continuous intake. Individualized instruction is much more complex to manage than semestered courses. It lends itself, again, most ideally to a computer management process. Since the time restriction can be removed with individualized instruction, intake can occur any time during the year. The only week the Digital Electronics program is actually shut down is the week between Christmas and New Years.

The Digital Electronics program has become totally modular using modules of study similar to the one you are currently reading. With these modules the student can take the same program days or evenings, full time or part time. With modular instruction students are able to do more of their program at home, on the job, or other places other than the classroom. This provides better utilization of space and hardware. "Class sets" of hardware are a thing of the past. Now, one or two pieces of more expensive equipment are all that are needed for perhaps 60 students. They don't all need it at the same time.

Scheduling of space and faculty are much simplified. Faculty are scheduled to fixed areas of learning. The students attend as they need to. The experience in the Digital Electronic program is that approximately 50 percent of the students need to attend at any given time for instruction and resources they can't find anywhere else. This doesn't mean faculty are any less busy, they are continually serving students on an individual basis.

Perhaps the most important advantage of individualized instruction is the fact that the students are forced to learn how to learn on their own. If there is any one single important gift a student walks away with for the future, this is it. When they aren't given any other choice in the matter they submit to it and begin to learn how to learn on their own. Most become confident learners and are very pleased with themselves.

Personal Notes:

In 1971 two great events were to change my teaching career until now and probably forever. The first event was do decide to individualize the course in Electronics I was teaching because the sponsored students were to be trickled in on a continuous intake. The second event was a seminar I attended conducted by a professor from the University of Minnesota by the name of Don Stewart. His book "Educational Malpractices" is well worth reading. I did find at this seminar the solution to the major problems that were troubling me about the system failing the student. Individualizing the instruction and tailoring it to the individual needs of the students was the answer. It is interesting to note, however, how important it is to have administrative support for this method of instruction. When this disappears it can almost decimate a program that can take years to build.

In 1982 I attended a conference at the University of Windsor for teachers who were individualizing instruction. The key note speaker was Dr. Fred Keller, a retired psychology professor from Columbia University. Dr. Keller was 84 at the time of this conference, and he delivered a spell binding speech for 45 minutes on individualizing instruction. Dr. Keller concluded in his speech that the computer would become the most important piece of hardware to influence both the management and delivery of learning, particularly for individualized learning programs.

Many teachers and administrators who know nothing about individualizing learning think that once a few I.L.P. packages have been developed there is nothing more to do. How wrong they are, this is just the beginning.

Challenges Implementing Individualized Instruction

The largest challenge that seems to get in the way of implementing individualized instruction are attitudes. The students have the least difficulty, if any, in accepting a change to individualized instruction. When the process is explained to them, they are usually curious to get started, and once started, don't want to turn back to the traditional system. Administrative attitudes vary, usually to the degree of extra work required by them. When truly objective, most administrators support the idea of individualization. The most difficult group to convince are teachers. Teachers who like a position of group control and like to hear themselves lecture are the most difficult group to change their attitudes. Once immersed in the system (voluntarily or involuntarily), most teachers who have the student as number one change attitudes very quickly towards the advantages of individualizing. Remember, the advantages to the student count the most. Having taught in both systems, I can guarantee a lot more work for the teacher who makes the commitment to individualized instruction and, also a lot more personal satisfaction. Some teachers think that those in the ILP system don't have to do anything other than show up in class at the right time. I wonder who they think prepares all the ILP materials and the infrastructure required to make it all happen?

Inexperienced faculty find a great deal of challenge starting in an individualized format. This is not from an attitude problem, but, not being familiar enough with course content to be able to function in all parts of a course simultaneously. Teaching in a traditional mode, the teacher usually only has to be on top of a week or two's work at any one time. They can prepare ahead as the need schedules. As they teach a course repeatedly, they will become more comfortable being able to deal with all parts simultaneously. In an individualized instructions setting, the teacher has to be very familiar with ALL parts of the course ALL of the time.

Individualized instruction courses require a more complex management of educational resources, lab equipment and records. For example, in a tradition setting of 20 students doing a lab project paired in twos, would required 10 sets of hardware. However, if not all of the students require the same hardware at the same time, maybe one or two sets are all that are required. One has to do a more detailed analysis of utilization to plan what is required in the way of resources.

Module 3

Continuous Intake

Module Overview

Participants will identify and observe the concepts used in the Digital Electronics Program at Humber College to allow the continuous intake of students into the program.

Resources

General

Slide presentation

Print

Contained within this module

92 03 30

Objectives

Objective	Learning Activity
1. Participants will be able to identify the advantages of continuous intake.	**Reading Activities:** (a) Participants can start a course or program when it is convenient to them. (b) When participants trickle in, graduates trickle out. (c) Less competition for available jobs upon graduation. (d) Employers require graduates all year round and will look for continuous intake graduates all year round when required. (e) Better resource utilization. (f) Faculty have wider choice of vacation periods. (g) Faculty have greater choice of professional development activities and courses. (h) For a more detailed explanation of each of the above points read page 4 in this module.

Objective	Learning Activity
2. Participants will be able to identify the challenges of implementing continuous intake.	**Reading Activities:** (a) Requires more complex management of course materials. (b) Requires more complex management of student records. (c) Challenging for inexperienced faculty. (d) Resources and registration are very often geared for semester intakes. (e) For a more detailed explanation of each of the above points read page 5 in this module.

Advantages of Continuous Intake

One of the most important advantages of year round continuous intake is that the student can start his or her course when it is convenient to them. The convenience of when they want to start a course may be dictated by their personal goals and when they have to be achieved by. It may be determined by some production goal of an employer. A student who is unemployed may rather start their course in April rather then sit unemployed or take part time jobs until ăn opportunity to start occurs in September. Perhaps if they have to support themselves to September as well as take the course, they won't be able to afford to take the course. In any other part of the market place, when a buyer wishes to make a purchase, they don't want to wait 6 months to receive their purchase. Why should the purchase of an education be any different? Continuous intake of students does, however, preclude the use of individualized instruction.

When participants trickle into a program or course on a continuous intake basis, they trickle out. Jobs come available all year round, not just in May or June. When graduates trickle out, there may be only one or two graduates competing for the jobs available in that time period. This provides a lot less competition than if 50 or 100 are graduating for the same number of jobs in May or June. Certainly in these periods of recession this feature is greatly appreciated by graduates. In fact, if a long period of recession should continue, and we don't graduate on a more continuous basis, we will endanger our very existence. Another benefit occurs when employers learn that graduates are available for graduation all year round, they will go looking for graduates to place at odd times of the year because they can be reasonably sure it won't be long until someone is available. They will be able to fill positions as they become available. All of these features have benefited the participants and graduates of the Digital Electronics program at Humber College.

With continuous intake all year round there is much better utilization of resources. Instead of resources lying idle for up to 4 months of the year, they are utilized all year. As a result more students can use the same resources in the period of one year. Students also pay their tuition all year providing added income to the institution.

Faculty involved in year round continuous intake programs can choose their vacation periods and professional development activities at times that may be more advantageous to the faculty. For example, in the Digital Electronics program at Humber College there are 2550 teaching hours annually. If each professor's annual contracted teaching load is approximately 650 hours, then the load can be shared by approximately 4 professors. It works out that in any given week, one of the four professors is off duty, either on vacation, doing course preparation, or professional development activities. When these activities occur, or which one of the four professors is off duty, is irrelevant for any given week of the year, because each student is working individually and each week of instruction is the same, only the players change.

Challenges Implementing Continuous Intake

Continuous intake requires more complex management of course materials and resources as well as student records. It is not more difficult, just more complex. The greatest challenge is knowing how many pieces of any given resource is needed at any given time. With semestered groups, one can produce "class sets". However, with continuous intake one doesn't generally require class sets of anything. Depending on how often a resource will be used by a student and for how long a period will determine the number required. For example if there are 60 students in a course and a particular resource is used for 10 percent of the student's course, than 6 units should suffice. Having to purchase only 6 is definitely an advantage, but the challenge lies in determining accurately what percentage of the time it will be used. The worst case scenarios occur when 5 or six more students then usual start on a given day. This will stress the initial resources. Extras are usually kept on hand and soon the students pace themselves apart as they learn at different rates.

College wide resources are often geared for semester intake and if continuous intake groups represent small numbers than it is often difficult to get the attention from groups like libraries and cafeterias at "odd" times of the year.

Inexperienced faculty find a great deal of challenge starting in a continuous intake format. This is not from an attitude problem, but, not being familiar enough with course content to be able to function in all parts of a course simultaneously. Teaching in a lock step semester mode, the teacher usually only has to be on top of a week or two's work at any one time. They can prepare ahead as the need schedules. As they teach a course repeatedly, they will become more comfortable being able to deal with all parts simultaneously. In an continuous intake setting, the teacher has to be very familiar with ALL parts of the course ALL of the time.

Module 4

Computer Managed Learning

Module Overview

Participants will identify and observe the concepts used in the Digital Electronics Program at Humber College to implement computer managed learning.

Resources

General

Slide presentation

Print

Contained within this module

92 04 08

Objectives

Objective	Learning Activity
1. Participants will observe the history of the implementation of computer managed learning at Humber College.	**Reading Activities:** (a) 1971 Course objectives typewritten on McBee cards. (b) 1971 Test questions each written on McBee cards. (c) 1971 Study guides prepared from photo copies of McBee cards. (d) 1975 Test grading system initiated on Digital PDP-8 computer. (e) 1976 Study guides prepared by first CML system developed on Digital PDP-8 computer. (f) 1978 Test grading system initiated on Commodore PET microcomputer system and Digital PDP-8 abandoned for this purpose. (g) 1979 Study guides prepared on commercially available word processing software for Commodore PET microcomputer system. Digital PDP-8 abandoned for this purpose. (h) 1983 Study guides prepared on IBM PC using Word Perfect. (i) 1989 to present, C.B.T.S. - S.A.I.T. (now Campus America) computer managed learning system implemented. Commodore PET's abandoned. IBM PC using Word Perfect used to create study guides and test questions and then uploaded into LMS system. (j) For a more detailed explanation of each of the above points read page 5 in this module.

Objective	Learning Activity
2. Participants will be able to identify the advantages in implementing computer managed learning.	**Reading Activities:** (a) Complete test management. (b) Complete study guide management. (c) Complete student record management. (d) Dynamic on line updates of test questions and study guides. (e) Complete statistical analysis of student records. (f) Complete statistical analysis of test question performance. (g) Students obtain tests and assignments on their own schedule. (h) Assignments, tests, and study guides are available remotely. (i) All test banks, study guides, and course templates are in electronic format. (j) For a more detailed explanation of each of the above points read pages 6 to 8 in this module.

Objective	Learning Activity
3. Participants will be able to identify the requirements to implement a computer managed learning system.	**Reading Activities:** (a) Identify and write different types of test questions. (b) Identify and use VAX EDT editor commands. (c) Identify and write module statements. (d) Identify and write objective statements. (e) Identify and create course templates and maps. (f) Identify and use LATEX commands. (g) Create study guides. (h) Identify creation order for different programs. (i) Troubleshoot and repair test banks, course templates, and study guides. (j) For a more detailed explanation of each of the above points read pages 9 to 11 in this module.

History of Computer Managed Learning

The sequence of the implementation of computer managed learning for the Digital Electronics program at Humber College is sufficiently documented in the learning activities for this module under objective 1. Obviously each step of the way became more sophisticated in the process. The item worth noting here, however, is the use of Word Perfect in the creation of materials used in the LMS system. One can create everything required on the VAX terminal to produce all the requirements of LMS, however, word processors such as Word Perfect are much more sophisticated than the EDT text editor in the VAX, and, it can be much more efficient producing documents in Word Perfect or any other favourite word processor. Once they are produced, they need to be converted to a text file. Once in this format, they can be uploaded into the VAX using communication software that would normally be used with a modem. Procomm is a good example. You cannot use any of the special buried word processor commands such as bolding or underscoring. They will be lost in the text conversion process. One of the techniques used in the Digital Electronics program is to have secretaries who know nothing about LMS do the brute force typing of test questions and documents such as the one you are reading now in Wordperfect. Some time later, the facilitator of the LMS system takes the files created by the secretary in Word Perfect, edits them to fit the LMS system, then uploads the material into the VAX. The secretary doesn't need to know anything about the system.

Advantages of Computer Managed Learning

There are various degrees in which one can implement the computer managed learning system. The LMS system used by the Digital Electronics program at Humber College allows the teacher or learning manager to implement as little or as much of the system as required at any given stage. It is best to start small and add on as one becomes more experienced. In the simplest form, one can use it as a test - lab grade record system. In this way each test is graded manually and the grades are entered manually for each student project. From this implementation the facilitator would be able to produce weighted grade reports for each student and group statistical analysis.

The next most obvious use of the system is to set up test banks. With these questions, it is possible to test each student with controlled random sets of questions for each objective of the student's program. Each student can enter their answers in the system and have them graded and recorded.

In the Digital Electronics program the complete use of the test bank functions is in use. The following is a description of how it is used. This is not meant to be how it should be used, but an example of how it can be used. For each objective, students are given open book homework assignments that must have a minimum grade of 80 percent before the student can proceed to the next assignment. A student may have three tries at each of these assignments before a mandatory intervention by the evaluator. The computer will generate random questions in each of these assignments. Once the minimum grade of 80 percent is reached the student will proceed to the next assignment. The highest of the grades will be used for the summative evaluation. The homework assignments will count for 20 percent of the Theory evaluation for each subject.

Each closed book supervised test is conducted in the college test center where a laser printer produces their test. Each test must have a minimum grade of 60 percent before the student can proceed to the next assignment. A student may have two tries at each of these tests before a mandatory intervention by the evaluator. The computer will generate random questions in each of these assignments. Once the minimum grade of 60 percent is reached the student will proceed to the next assignment. The highest of the grades will be used for the summative evaluation. The supervised tests will count for 30 percent of the Theory evaluation for each subject.

Each closed book final subject test also given in the college test center must have a minimum grade of 60 percent before the student can proceed to the next assignment. A student may have two tries at each of these tests before a mandatory intervention by the evaluator. The computer will generate random questions in each of these assignments. Once the minimum grade of 60 percent is reached the student will proceed to the next assignment. The highest of the grades will be used for the summative evaluation. The supervised tests will count for 50 percent of the Theory evaluation for each subject.

Each lab project with a lab test will count for 60 percent of the raw score for the lab and the lab test will count for 40 percent of the raw score for each lab. All of the lab project raw scores will be averaged for the Lab grade for each subject. Some lab project scores are entered by the teacher and others are created by having the student enter their measurements and data from the lab project.

The final Theory grade and the final Lab grade will each count for fifty percent of the final grade in each subject. The computer manages all of the scores.

At the moment over two thousand questions have been developed in the test banks for the Digital Electronics program. I have always felt that the weighting of evaluation is of minor importance compared to making sure that students have mastered the skills and objectives that are required. I also maintain the sole purpose of an evaluation is to find out what the student DOESN'T know. It is with this information I CAN help a student.

The module study guide draws together the module statement, the resources, the objective statements, and the learning activities. When activating the study guide function a template is automatically made up. All the user has to do is to type in the resources and the learning activities. An example print out of a module study guide is the package you are reading now. Although I haven't attempted to incorporate graphics and pictures into the study guide file, it is capable of handling these.

The complete study guide package brings together all of the required module packages produced by the LMS system. A complete set of study guide packages make up the courses for the Digital Electronic program. It is possible using this technique for a course to be made up individually for any student. From the student's perspective, a selection of appropriate module study guides bound together would make up that student's unique course.

The module study guide and test questions can be corrected on line in minutes as problems are identified. Initially a small number of these study guides are printed. This forces a new revised set to be printed. The new revised set will incorporate all of the changes. The system will look after renumbering sections and pages etc. The study guide given to our students would comprise of the front page cover sheet, the course outline, the module study guides, and the diagrams required to answer the assignments.

The test bank history provides a print out of the success, or lack there of, of every question in the test bank. What has to be researched is whether the question is the problem or whether there are insufficient learning activities to answer the question.

With the use of a home computer, students can access assignments and study guides. When assignments are complete, students can also enter their answers at home into the system for grading and receive an immediate report back.

What ever is running has to be made to run well before adding other features. Our whole program is being rewritten and brought to the standards previously mentioned. As this occurs, changes is technology can be constantly added and updated. As other good resources are discovered such as video tapes, they too will be evaluated and added. The most important part is here now - infrastructure. It is in electronic format for easy editing. This will be here even if the authors are not. It becomes the best effort of all teachers and all students.

Implementing a Computer Managed Learning System

In the Digital Electronics program at Humber College, we have standardized on the Learning Management System (LMS) sold by Campus America in Knoxville TN. The system was first marketed by C.B.T.S. in Calgary AB. The customer service is run by Campus America from the Southern Alberta Institute of Technology (S.A.I.T.) in Calgary AB.

The following steps are required to implement the computer managed learning system.

1. Prepare module statements.
2. Prepare course outline.
3. Prepare objective statements for each module statement.
4. Prepare test questions for each objective statement.
5. Prepare diagrams for each test question requiring them.
6. Prepare learning activities for each objective statement.
7. Prepare a module package for each module statement.
8. Prepare a course map and template.
9. Enrol students.
10. Track student progress.

Learning Strategies:

1. Identify how module statements are created in the LMS test bank.
2. Identify functions of VAX EDT editor.
3. Identify relationship between LMS module numbers and module statements.
4. Identify word processing functions to prepare course outline.
5. Identify how objective statements are created in the LMS test bank.
6. Identify how test questions are created in the LMS test bank.

7. Identify how to create questions in a conventional word processor such as Wordperfect.
8. Identify how to up load questions created in a conventional word processor into the LMS system.
9. Identify EDT editor copy process.
10. Identify how learning activities are written in the LMS study guides.
11. Identify Latex word processor commands for the VAX EDT editor.
12. Identify the components of LMS course map and their purpose.
13. Identify the process of enroling students in the LMS system.
14. Identify the process of obtaining LMS statistics on student progress.
15. Identify the process of obtaining LMS statistics on test bank question success.

Results:

1. The module statements prepared will appear in any statement of objectives from the LMS system, and, should be synonymous with any appearing on a course outline sheet.
2. Learning to prepare a course outline using a word processor will allow the knowledge used to be used for many other applications of the word processor. The word processing system used for the course outline used in this package was Waterloo Script resident on Humber College's mainframe computer. Boxes and columns are easy and it is attached to a laser printer.
3. One learns to write a set of objective statements that must in every detail be a sub set of the module statements.
4. One learns to write questions that turn the objective statements into questions. This in turn insures an exact co- relationship between objective and question.
5. One learns to write learning activities that turn the objective into an action on the part of the student. If done correctly the action on the part of the student matches the objective written. This in turn insures an exact co- relationship between objective, learning activity and test questions.

6. The teacher can now see the fruit of his or her efforts. The module statements, the objective statements, and the learning activities all come under one decent looking package called a learning module package. One can then take any number of these packages, combine them in any order if that is the wish, and produce a complete study guide for a course. The modules don't have to share the same test bank.

7. The course map puts together all the testing parameters. The teacher can see how and when each objective is going to be tested.

8. Enroling students initiates activity with the learning system. In the individualized system of instruction, the teacher sees how all the previous activities he or she has prepared start to activate learning in the student. One quickly learns from the questions the students are asking or not asking, what parts of all the previous preparation is successful and what parts still need some more work. The system does provide the dynamic ability to provide on line fixes that will immediately affect the product given to all following students.

9. The LMS system provides the teacher with a very comprehensive set of statistics both on student progress as well as group success. The teacher can use these statistics to learn where weaknesses lie in the system. With some critical path analysis the teacher will be able to correct problems that affect the greatest number of students first and then work down to those affecting the least number of students.

Module 5

Learning Management System (LMS)

Module Overview

Participants will be familiarized with the application of Campus America's "LMS" system in the Digital Electronics program at Humber College.

Resources

General

Slide presentation

Print

Contained in this package.

92 04 15

Objectives

Objective	Learning Activity
1. Participants will observe typical "LMS" menu screens as observed by student and faculty users of "LMS".	**Reading Activities:** (a) At the end of this package their will be a series of LMS screens that will be observed by the user of the system. On page 6 you will see the general login screen observed each time a student or faculty member uses the system. This is called the identification screen as identified at the top center of the screen. More details will be described on the example page. (b) Page 7 shows the student menu screen 3.8. This is the menu that the students can choose from. More details will be described on the example page. (c) Page 8 shows the faculty menu screen 1.0. This is the menu that the faculty can start to choose from. The items on this screen normally lead to more menu screens. More details will be described on the example page. (d) Page 9 shows the faculty management functions screen 3.5.3. This is the menu that will be normally used on a day to day basis in the class or lab. More details will be described on the example page.

Objective	Learning Activity
2. Participants will observe a typical report screen as observed by student and faculty users of "LMS".	**Reading Activities:** (a) Page 10 shows a typical student history report. If activated by the student, this will produce a hard copy. If activated by a teacher, a choice of screen view or hard copy is available. (b) Page 11 shows a typical student report where various weighting is assigned to different modules. An entire set of class reports can be generated at once, each having the same format as the one displayed on page 11.
3. Participants will observe a sample of the method of writing module statements and objective statements in the "LMS" system.	**Reading Activities:** Page 12 shows the definition of the module statement and objective statements for module 1 in a physics course taught at Humber College. The syntax shown is the required syntax for entering module and objective statements in the test bank.

Objective	Learning Activity
4. Participants will be able to identify the different types of questions that can be used with "LMS".	**Reading Activities:** (a) Page 13 shows the syntax of entering a multiple choice type question called a "type 01" question by the system definitions. (b) Page 14 shows the syntax of entering a "string" answer type question called a "type 03" question by the system definitions. (c) Page 15 shows the syntax of entering a "numeric" answer type question also called a "type 03" question by the system definitions. (d) Page 16 shows the syntax of entering a "numeric" answer in a question that is designed to have random variables placed in the question. This is called a "type 05" question by the system definitions. (e) Page 17 shows the syntax of entering an "assignment" type question called a "type 09" question by the system definitions.

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Objective	Learning Activity
5. Participants will observe a sample of the method of writing a study guide using "LATEX" commands within the "LMS" system.	**Reading Activities:** Pages 18 to 20 show a complete study guide template using "LATEX" commands. This is type of word processing language the user has to learn because all the "buried" commands usually produced by a PC word processor have to be learned and entered manually. Graphics files can also be called up to produce pictures, graphs etc. within the document.
6. Participants will observe a sample of a course outline sheet adapted for use with "LMS".	**Reading Activities:** Page 21 and 22 show typical course outline sheets used in the Digital Electronics program for the "Logic" course. Each of the topics are the titles associated with the module statements.
7. Participants will observe a sample of an "LMS" course template and be able to identify its function.	**Reading Activities:** Pages 23 to 30 shows a complete course template that sets up the controls on passing grades, time limits, numbers of questions, etc. for assignments, tests and exams. Theoretically, one of these could be made up for each student giving them a totally unique course to suit their individual needs. This is the place where unique courses can be set up using "tree branching" techniques. Here, common modules are used for different courses.

```
 LMS Version 3.0
Campus America
                                   IDENTIFICATION
================================================================================

 ELEC



        Please enter your LMS id and press <RETURN>:



        To leave LMS type LOGOUT and press <RETURN>


    Copyright (c) 1982, 1986, 1990, CBTS, Ltd.,  A Campus America Company

To sign off the computer, type LOGOUT
```

Identification Screen:

This screen that you see above is to log on to LMS. For the student, the id code will be the student's 9 digit student number entered as 9 consecutive digits. Other users will have unique codes such as their last name or group names. After entering your id code press the "RETURN" key. The user will then be prompted to enter their password. Again, press the return key after entering the password. The password will not "echo" on the screen.

```
 LMS Version 3.0
Campus America
                              STUDENT FUNCTIONS 3.8
================================================================================
   Last signed on: 900928 10:46                  Current date: 901018 08:40


         Please select one of the following

                 1) EXIT           - Exit from Student Functions
                 2) CHALLENGE      - Your selection of activity
                 3) PROCEED        - Do assigned activity
                 4) GUIDE          - Produce a Module Study Guide
                 5) HISTORY        - A report of your past performance
                 6) MAP            - See sequence of course requirements
                 7) MESSAGE        - Send a message
                 8) OBJECTIVES     - See Learning Objectives
                 9) PASSWORD       - Set a new password
                10) REVIEW         - Review a completed course requirement
                11) STATUS         - A report of your current status
                12) LOCAL          - Local Site Procedures

Enter option number or name and press <RETURN>:
```

The Student LMS Menu:

The above menu is the one that the student will see at sign on. The normal items that the student will have access to will be items 1, 3, 5, 6, 7, 8, 9, 10, and 11. At the present time the other items have not been activated. Each of the items should be self explanatory in the menu. Item 2 can be made active.

```
 LMS Version 3.0
Campus America
                                LMS MODULES 1.0
================================================================================

        Please select one of the following
        or type HELP for additional information:


              1) EXIT          - Return to LMS Identification Screen
              2) TMM/TESTBANK  - Testing Management Module
              3) CMM/COURSE    - Course Management / Student Module
              4) TAM           - Testing Analysis Module
              5) CAM/ANALYSIS  - Course Analysis Module
              6) SECURITY/USER - Establish User Security
              7) LOCAL         - Local Site Procedures
              8) RMM/NORM_REF  - Records Management Module
              9) CBIM/CAI      - Computer Based Instruction Module

Enter option number or name and press <RETURN>:
```

Faculty Menu Screen:

As a system operator you will have limited access to menu items 1, 2, 3, 5, and 6.

Menu item 1 will put you back to the previous menu for logout.

Menu item 2 will allow you access to the testbank to view questions and answers. You will not be able to change them.

Menu item 3 will allow you access to student files.

Menu item 5 will allow you access to statistical information.

Menu item 6 will allow you change your password only.

```
 LMS 3.0
Campus America
                          MANAGEMENT FUNCTIONS 3.5.3
================================================================================
Course: ELCERTA

        Please select one of the following
        or type HELP for additional information:


 1) EXIT        - Return to last menu  |  8) MESSAGE    - Send student message
 2) CONDITIONAL - Set conditional pass |  9) PASS       - Pass subject test
 3) CREDIT      - Credit a subject     | 10) RELEASE    - Release LOCK_OUT
 4) EXAM        - Release an exam      | 11) RESET      - Reset message key
 5) FAIL        - Fail subject test    | 12) SCORE      - Change student score
 6) LOCK_OUT    - Stop LMS access      | 13) TIME       - Cancel time lockout
 7) MASS        - Send message to class| 14) UPDATE     - Send subject update


Enter option number or name and press <RETURN>:
```

Faculty Management Functions:

Each of the items from this menu should be self explanatory. You will notice that a student exam can be released to the student by choosing 4. This would be required when the course designer puts an intentional stop in the students course so that the exam can only be released under supervision. Do not use (3) to credit a test. This will give credit to an entire subject such as DC circuits.

Report: 3.5.2.5 Course.Supervisor.Report.History Page 1
on subject DC for xxx xxx xxx John Doe 10-APR-1992

MODS/ TESTS	STARTING DATE/TIME	COMPLETION DATE/TIME	ATTEMPTS PASS	ATTEMPTS TOTAL	SCORES 1	SCORES 2	SCORES 3	SCORES 4	LAST
10	911202 10:53	911204 14:03	3	3	83	83	83	0	0
15	911204 14:05	911206 11:18	1	1	94	0	0	0	0
16	911206 11:20	911209 11:01	1	1	93	0	0	0	0
25	911209 11:03	911209 13:21	1	1	100	0	0	0	0
130	911209 13:22	911210 15:03	1	1	90	0	0	0	0
31	911210 15:06	911211 10:14	1	1	100	0	0	0	0
135	911213 14:33	911213 14:33	0	0	90	0	0	0	0
136	911213 14:34	911213 14:34	0	0	90	0	0	0	0
137	911213 14:35	911213 14:35	0	0	100	0	0	0	0
41	911213 14:38	911216 11:06	1	1	85	0	0	0	0
145	911216 15:15	911216 15:15	0	0	85	0	0	0	0
46	911216 15:18	911217 10:11	1	1	100	0	0	0	0
51	911217 10:16	911217 13:38	1	2	83	0	0	0	0
160	911217 13:44	911218 14:18	1	1	90	0	0	0	0
161	911219 10:09	911219 10:31	1	1	90	0	0	0	0
62	911219 10:33	911219 13:02	1	1	100	0	0	0	0
S01	911220 09:57	911220 11:29	1	1	86	0	0	0	0
165	920106 14:32	920106 14:32	0	0	100	0	0	0	0
166	920107 15:17	920107 15:17	0	0	90	0	0	0	0
167	920109 11:07	920109 11:07	0	0	70	0	0	0	0
168	920110 11:34	920110 11:34	0	0	90	0	0	0	0
69	920110 12:49	920115 13:10	2	2	42	92	0	0	0
170	920116 13:07	920116 13:07	0	0	90	0	0	0	0
71	920116 13:10	920120 10:08	1	2	100	0	0	0	0
81	920120 11:04	920120 14:43	1	2	100	0	0	0	0
185	920121 10:00	920122 15:23	1	1	80	0	0	0	0
86	920122 15:24	920123 09:54	1	2	100	0	0	0	0
S02	920123 10:28	920123 12:14	1	1	90	0	0	0	0
E01	920124 09:57	920124 12:31	0	0	90	0	0	0	0

Typical Student History:

Report: 5.6.2 Analysis.Grades.Student Page 1
for Course ELCERTA Subject AC 15-APR-1992

NAME IS : Doe, Jane ID = xxx xxx xxx

EXAM	SCORE (%)					SCORE-USED	WEIGHT	WEIGHTED SCORE
205	100	0	0	0	0	(H) 100.00	0.010	1.00
110	80	0	0	0	0	(H) 80.00	0.029	2.29
111	100	0	0	0	0	(H) 100.00	0.038	3.75
12	93	0	0	0	0	(H) 93.00	0.010	0.93
115	100	0	0	0	0	(H) 100.00	0.038	3.75
16	78	100	0	0	0	(H) 100.00	0.010	1.00
120	67	100	0	0	0	(H) 100.00	0.029	2.86
121	80	0	0	0	0	(H) 80.00	0.038	3.00
22	80	0	0	0	0	(H) 80.00	0.010	0.80
S01	85	0	0	0	0	(H) 85.00	0.075	6.38
125	100	0	0	0	0	(H) 100.00	0.029	2.86
126	100	0	0	0	0	(H) 100.00	0.038	3.75
27	56	100	0	0	0	(H) 100.00	0.010	1.00
130	83	0	0	0	0	(H) 83.00	0.029	2.37
131	100	0	0	0	0	(H) 100.00	0.038	3.75
32	44	90	0	0	0	(H) 90.00	0.010	0.90
35	64	93	0	0	0	(H) 93.00	0.010	0.93
140	100	0	0	0	0	(H) 100.00	0.029	2.86
141	100	0	0	0	0	(H) 100.00	0.038	3.75
42	50	92	0	0	0	(H) 92.00	0.010	0.92
145	100	0	0	0	0	(H) 100.00	0.029	2.86
146	95	0	0	0	0	(H) 95.00	0.038	3.56
47	58	100	0	0	0	(H) 100.00	0.010	1.00
150	100	0	0	0	0	(H) 100.00	0.029	2.86
151	90	0	0	0	0	(H) 90.00	0.038	3.38
52	100	0	0	0	0	(H) 100.00	0.010	1.00
S02	90	0	0	0	0	(H) 90.00	0.075	6.75
E01	85	0	0	0	0	(H) 85.00	0.250	21.25
							FINAL	91.48

```
.module =   1
.ms
Motion
Participants will analyse the principles of motion by solving
problems related to speed, distance, acceleration, and gravity.
.objective =   1
.os
Participants will analyse and solve problems relating speed,
distance and time.
.objective =   2
.os
Participants will analyse and solve problems relating acceleration,
speed, distance, and time.
.objective =   3
.os
Participants will analyse and solve problems relating the affects of
gravity, acceleration, speed, distance, and time to falling bodies.
```

Module and Objective Statements:

The module statement is the first objective labeled "Motion".

The objective statements follow the objective number.

```
.module =  24
.objective =   1
!
!  The following question was  2410400
!
.question =   4
.answer = E
.header = 010102020011200
.body
When waves of light meet and cancel each other out, the waves
are said to be:

     a.  Interfering constructively

     b.  In phase

     c.  Coherent

     d.  Incoherent

     e.  Interfering destructively
```

Multiple Choice - Question Type 01:

The first four numbers in the question header "0101" tell the system to first print an instruction statement type "01" that will give the student instructions on how to answer the question. The second "01" instructs the system that the question is a multiple choice type question, and to expect an "a" to "f" or "1" to "6" type answer.

```
.module =  23
.objective =   2
!
!  The following question was  2320500
!
.question =   5
.answer = chromatic&CHROMATIC&Chromatic;
.header = 030302020011200
.body
Identify the type of lens aberation that causes different wavelengths
of light to be refracted slightly differently.

Enter your answer as one word.
```

String Answer - Question Type 03:

The first four numbers in the question header "0303" tell the system to first print an instruction statement type "03" that will give the student instructions on how to answer the question. The second "03" instructs the system that the question is a "string" type answer.

```
.module =   8
.objective =   1
!
!  The following question was   810100
!
.question =   1
.answer = 46.988 %.03;49.244 %.03;
.header = 050302020022200
.body
A sign weighing 25 newtons is suspended at one point below a
horizontal strut by two cables attached to each end of the
strut.  One of the cables makes an angle with the strut of 10
degrees and the other cable makes an angle with the strut of 20
degrees.

1.  What is the tension in the cable making the angle of 10
    degrees?

2.  What is the tension in the cable making the angle of 20
    degrees?
```

Numeric Answer - Question Type 03:

The first four numbers in the question header "0503" tell the system to first print an instruction statement type "05" that will give the student instructions on how to answer the question with a numeric answer. The second "03" instructs the system that the question is a "numeric string" type answer. The number value following the percentage sign shown in the answer line indicates the acceptable tolerance that will be accepted. ".03" indicates that any answer will be acceptable that is within plus or minus 3 percent of 46.988 for the first answer and 49.244 in the second answer. Note also that it is possible to have up to nine different answers called for within one question with the LMS system.

```
.module =  23
.objective =   3
!
!  The following question was  2330100
!
.question =   1
.header = 050502020011200
.body
Using the mirror equation determine the focal length in cm of a
concave spherical mirror if the source object is ## cm from the
mirror and the image observed is ## cm from the mirror.
.SUBSTITUTIONS
p(10,20,1)
q(10,20,1)
.SOLUTIONS
f = (p*q)/(p+q);
.RESULTS
"Focal length in cm=",f,.03
```

Numeric Answer With Random Variables - Question Type 05:

The first four numbers in the question header "0505" tell the system to first print an instruction statement type "05" that will give the student instructions on how to answer the question with a numeric answer. The second "05" instructs the system that the question is a "numeric" type answer that has to be calculated from a formula placed in the solution for the question using the random variable generated within the question. The random variable can also be derived randomly from specific rows and columns of a "look up" table. The "results" part of the question specify the variable being solved for by the student and the acceptable answer tolerance.

```
.module =  99
.objective =   1
!
!  The following question was  9910100
!
.question =   1
.header = 090902020151200
.body
Prepare an assignment for your physics class according to the criteria
set out in the assignment sheet.
```

Assignment Answer - Question Type 09:

The first four numbers in the question header "0909" tell the system to first print an instruction statement type "09" that will give the student instructions that a hand in type assignment will be required and no entries will be made by the student into the computer in the way of answers. The second "09" instructs the system that the question is an"assignment" and not to expect any answers. A place will be created in the student's record file for a grade to be placed manually by the teacher. This is used in the Digital Electronics program to enter lab grades.

```
\module{28}{BOOLEAN ALGEBRA}
\section{Module Overview}
Participants will be able to relate complex logic circuits to
their truth tables and Boolean algebra expressions.
\section{Resources}
\subsection{General}
VAX terminal
\subsection{Print}
Digital Electronics - Third Edition and Activities Manual \\
Author: Roger Tokheim \\
Location: Bookstore \\
92 03 16 (3)
\clearpage
\section{Objectives}
\begin{objectivelist}
  \begin{objective}
    Particpants will be able to construct and identify logic circuits
    given the Boolean algebra expressions.
  \end{objective}
  \begin{activity}
{\bf Reading Activities:}
\begin{enumerate}
\item Refer to Digital Electronics - third edition by Tokheim.
\item Read pages 51 to 53.
\item Read pages 62 to 64.  (4-11)
\end{enumerate}
{\bf Self Test:}
\begin{enumerate}
\item Complete self test questions 1 to 7 on pages 52 and 53 as you
complete the readings.
\item Note:  The answer given on page 74 for question 4b does not
agree with the data given in the question.  Given the question as
it is there shouldn't be an inverter shown in the ``A" line of
the diagram.  The diagram would agree if the value of ``A" term in
the boolean expression had been inverted.
\item Note: Although not mentioned in your text book, it is very
useful to be aware of DeMorgan's Theorems.  A ``NOR" gate
function is the same as an ``AND" gate with inverted inputs.  A
``NAND" gate function is the same as an ``OR" gate function with
```

```
inverted inputs. \\

\hspace*{1in}$\overline{A+B} = \overline{A}\bullet\overline{B}$ \\

\hspace*{1in}$\overline{A\bullet B} = \overline{A}+\overline{B}$
\item Complete self test questions 22 to 24 on page 64 as you complete
the readings.
\end{enumerate}
  \end{activity}
\clearpage
\objhead
  \begin{objective}
    Particpants will be able to construct and analyse truth tables
    given a Boolean algebra expression.
  \end{objective}
  \begin{activity}
{\bf Reading Activities:}
\begin{enumerate}
\item Refer to Digital Electronics - third edition by Tokheim.
\item Read pages 53 to 56.
\end{enumerate}
{\bf Self Test:}

Complete self test questions 8 to 14 on pages 55 and 56.
  \end{activity}
  \begin{objective}
    Particpants will be able to analyse data selector circuits.
  \end{objective}
  \begin{activity}
{\bf Reading Activities:}
\begin{enumerate}
\item Refer to Digital Electronics - third edition by Tokheim.
\item Read pages 64 to 67.
\end{enumerate}
{\bf Self Test:}

Complete self test questions 25 to 32 on pages 65 to 67 as you
complete the readings.
```

```
{\bf Summary:}
\begin{enumerate}
\item Read the summary points 1 to 5 and 7 to 9 on pages 71 and 72.
\item Answers to self tests can be found on pages 74 to 76.
\end{enumerate}
  \end{activity}
\clearpage
\objhead
  \begin{objective}
Participants will complete a lab project to demonstrate the
applications of data selectors.
  \end{objective}
  \begin{activity}
{\bf Lab Activites:}
\begin{enumerate}
\item Refer to the Activities Manual for Digital Electronics.
\item Complete lab project 4-4 on pages 48 to 51.
\item Have your instructor enter the grade for this lab for module 25.
\end{enumerate}
{\bf Post Test:}

Go to a VAX terminal now, log on, and you will be given the post test
for module 28.  When you have completed it, log back on and enter your
answers.  A print out will give you your results when you have completed
the entry of your answers.  Diagrams for questions referring to diagrams
for module 28 can be found on page 5 of this module.
  \end{activity}
\end{objectivelist}
\clearpage
{\brt Diagrams for Module 28}
```

Latex Study Guide Template Example:

H U M B E R C O L L E G E - T E C H N O L O G Y D I V I S I O N

Electronics Certificate Programme

OUTLINE OF LEARNING MODULES

The Logic Circuits course is an introductory course in electronic circuits that are typically used in any digital based piece of electronic equipment such as a computer or other controller type equipment that operate as a result of some timing sequence or perform some sort of decision making. Participants will require the information learned as a foundation for learning the principles of all microprocessor and computer circuits.

LOGIC CIRCUITS - THEORY AND PRACTICE			
LMS Module NUMBER	TEST OR EXPERIMENT CODE	MODULE NAME	TARGET WEEKS
11	Assignment	Number Systems	25
15 16 17 18 19 20 21	Lab 3-2 Lab 3-3 Lab 3-4 Lab 3-5 Lab 3-6 Lab 3-7 Assignment	Logic Circuits	25
25 28	Lab 4-4 Assignment	Boolean Algebra	26
30 32	Lab 5-3 Assignment	Digital Integrated Circuits	26
45 47	Lab 6-2 Assignment	Digital Displays	26
50 51 52 54	Lab 7-2 Lab 7-3 Lab 7-4 Assignment	Flip-Flops	27
S01	Exam	Supervised Test 1	27

PAGE 2

60 62	Lab 8-4 Assignment	Counters	27
65 67	Lab 9-2 Assignment	Shift Registers	27
70 72	Lab 10-4 Assignment	Arithmetic Circuits	28
75 76	Lab 11-2 Assignment	Digital Memory Devices	28
80 81 82	Lab 13-3 Lab 13-5 Assignment	Digital-Analog Connections	29
S02	Exam	Supervised Test 2	29
E01	Exam	Final Test on DIGITAL CIRCUITS	29

Testbank: EEDIG01
Course: ELCERTD
Subject: LOG

Text Book: Digital Electronics by Roger Tokheim
Lab Book: Activities Manual for Digital Electronics by Roger Tokheim
Location: Book Room - Borrowed items

LMS_5A DTM 92 04 17

```
! Course Template.

! Course definitions.
! --
Course ELDC -
    /Subjects = (DC)
! +
! Default definitions.
! -
! Set up Typical Default for Modules

Default 1 -
        /Pass_mark = 80 -
        /Time_limit = 0 -
        /Number_of_Questions = -3 -
        /Exams_issued -
        /Nosupervised -
        /Challenge -
        /Review = 0 -
        /Min_attempts = 1 -
        /Max_attempts = 3 -
        /Auto_pass_attempt = 9 -
        /Answers_issued_attempt = 9 -
        /Lock_level = 2 -
        /Display_format = 1 -
        /Correct_answers = 0 -
        /test_format = 1

! Set up Typical Default for Group exams.

Default 2 -
        /Pass_mark = 60 -
        /Time_limit = 120 -
        /Number_of_Questions = 20 -
        /Exams_issued -
        /Nosupervised -
        /Review = 0 -
        /Min_attempts = 1 -
        /Max_attempts = 1 -
```

```
        /Auto_pass_attempt = 9 -
        /Answers_issued_attempt = 9 -
        /Lock_level = 2 -
        /Display_format = 0 -
        /Correct_answers = 0 -
        /Test_format = 2

! Set up for Supervised Exams

Default 3 -
        /Pass_mark = 60 -
        /Time_limit = 120 -
        /Number_of_Questions = 20 -
        /Exams_issued -
        /supervised -
        /NOChallenge -
        /Review = 0 -
        /Min_attempts = 1 -
        /Max_attempts = 2 -
        /Auto_pass_attempt = 9 -
        /Answers_issued_attempt = 9 -
        /Lock_level = 6 -
        /Display_format = 0 -
        /Correct_answers = 0 -
        /Test_format = 1

! Set up for Lab Reports

Default 4 -
        /Pass_mark = 60 -
        /Time_limit = 0 -
        /Number_of_Questions = 1 -
        /Exams_issued -
        /NOsupervised -
        /Challenge -
        /Min_attempts = 1 -
        /Max_attempts = 1 -
        /Auto_pass_attempt = 9 -
        /Answers_issued_attempt = 9 -
```

```
        /Lock_level = 2 -
        /Display_format = 0 -
        /Correct_answers = 0 -
        /Test_format = 1

! ++
! Subject definitions.
! --

Subject DC -
        /Question_banks = (EEDC01) -
        /Sequence = (10,15,16,20,21,22,24,25,29,31,35,36,39,40,42, -
                     43,44,45,97,47,48,49,50,51,52,53,54,55,56,57, -
                     62,S,63,64,65,66,67,68,69,75,80,81,83,84,85, -
                     86,S,E) -
        /Lockout_time = 30 -
        /Default = 1

! Change a specific map entry prescription

Entry 20 -
        /Default = 4

Entry 21 -
        /Default = 4

Entry 22 -
        /Default = 4

Entry 24 -
        /Default = 4 -
        241/Selection=24101/NQ=1/ORDER -
        241/Selection=24102/NQ=1 -
        241/Selection=24103/NQ=1 -
        241/Selection=24104/NQ=1 -
        241/Selection=24105/NQ=1 -
        241/Selection=24106/NQ=1 -
        241/Selection=24107/NQ=1 -
        241/Selection=24108/NQ=1 -
```

```
        241/Selection=24109/NQ=1 -
        241/Selection=24110/NQ=1

Entry 29 -
        /Default = 4 -
        291/Selection=29101/NQ=1/ORDER -
        291/Selection=29102/NQ=1 -
        291/Selection=29103/NQ=1 -
        291/Selection=29104/NQ=1 -
        291/Selection=29105/NQ=1 -
        291/Selection=29106/NQ=1 -
        291/Selection=29107/NQ=1 -
        291/Selection=29108/NQ=1 -
        291/Selection=29109/NQ=1 -
        291/Selection=29110/NQ=1 -
        291/Selection=29111/NQ=1

Entry 35 -
        /Default = 4 -
        351/Selection=35101/NQ=1/ORDER -
        351/Selection=35102/NQ=1 -
        351/Selection=35103/NQ=1 -
        351/Selection=35104/NQ=1 -
        351/Selection=35105/NQ=1 -
        351/Selection=35106/NQ=1 -
        351/Selection=35107/NQ=1 -
        351/Selection=35108/NQ=1

Entry 36 -
        /Default = 4

Entry 40 -
        /Default = 4

Entry 42 -
        /Default = 4

Entry 43 -
        /Default = 4 -
```

```
        431/Selection=43101/NQ=1/ORDER -
        431/Selection=43102/NQ=1 -
        431/Selection=43103/NQ=1 -
        431/Selection=43104/NQ=1 -
        431/Selection=43105/NQ=1 -
        431/Selection=43106/NQ=1 -
        431/Selection=43107/NQ=1 -
        431/Selection=43108/NQ=1 -
        431/Selection=43109/NQ=1 -
        431/Selection=43110/NQ=1

Entry 45 -
        /Default = 4

Entry 97 -
        /Default = 4

Entry 47 -
        /Default = 4

Entry 48 -
        /Default = 4

Entry 49 -
        /Default = 4

Entry 50 -
        /Default = 4 -
        501/Selection=50101/NQ=1/ORDER -
        501/Selection=50102/NQ=1 -
        501/Selection=50103/NQ=1 -
        501/Selection=50104/NQ=1 -
        501/Selection=50105/NQ=1 -
        501/Selection=50106/NQ=1 -
        501/Selection=50107/NQ=1 -
        501/Selection=50108/NQ=1 -
        501/Selection=50109/NQ=1 -
        501/Selection=50110/NQ=1
```

```
Entry 52 -
        /Default = 4

Entry 53 -
        /Default = 4

Entry 54 -
        /Default = 4

Entry 55 -
        /Default = 4

Entry 56 -
        /Default = 4

Entry 57 -
        /Default = 4 -
        571/Selection=57101/NQ=1/ORDER -
        571/Selection=57102/NQ=1 -
        571/Selection=57103/NQ=1 -
        571/Selection=57104/NQ=1 -
        571/Selection=57105/NQ=1 -
        571/Selection=57106/NQ=1 -
        571/Selection=57107/NQ=1 -
        571/Selection=57108/NQ=1 -
        571/Selection=57109/NQ=1 -
        571/Selection=57110/NQ=1

Entry S1 -
        /Default = 3 -
        /Printer = LAZER -
        /Range = 10:62 -
                /Exclude = (15,16,20,21,22,24,29,35,36,40,42,43, -
                            45,97,47,48,49,50,52,53,54,55,56,57)

Entry 63 -
        /Default = 4

Entry 64 -
```

```
        /Default = 4

Entry 65 -
        /Default = 4

Entry 66 -
        /Default = 4

Entry 67 -
        /Default = 4

Entry 68 -
        /Default = 4 -
        681/Selection=68101/NQ=1/ORDER -
        681/Selection=68102/NQ=1 -
        681/Selection=68103/NQ=1 -
        681/Selection=68104/NQ=1 -
        681/Selection=68105/NQ=1 -
        681/Selection=68106/NQ=1 -
        681/Selection=68107/NQ=1 -
        681/Selection=68108/NQ=1 -
        681/Selection=68109/NQ=1 -
        681/Selection=68110/NQ=1

Entry 80 -
        /Default = 4

Entry 83 -
        /Default = 4

Entry 84 -
        /Default = 4

Entry 85 -
        /Default = 4 -
        851/Selection=85101/NQ=1/ORDER -
        851/Selection=85102/NQ=1 -
        851/Selection=85103/NQ=1 -
        851/Selection=85104/NQ=1 -
```

```
        851/Selection=85105/NQ=1 -
        851/Selection=85106/NQ=1 -
        851/Selection=85107/NQ=1 -
        851/Selection=85108/NQ=1 -
        851/Selection=85109/NQ=1 -
        851/Selection=85110/NQ=1

Entry S2 -
        /Default = 3 -
        /Printer = LAZER -
        /Range = 69:86-
                /Exclude = (80,83,84,85)
Entry E1 -
        /Default = 3 -
        /Printer = LAZER -
        /Range = 10:86 -
                /Exclude = (15,16,20,21,22,24,29,35,36,40,42,43, -
45,97,47,48,49,50,52,53,54,55,56,57,63,64,65,66,67,68,80,83,84,85)
END
```

Course Template:

The previous pages display a typical course template used to manage a specific course or series of subjects within a course.